Using Interactive Maps in Community Applications

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ABSTRACT
Interactive maps provide unique ways to support community applications. In particular, they enable new collaborative activities. Map-based navigation supports a community environment as well as virtual tours. Interactive maps can also function as a tool in collecting historical information and discussing new spatial layouts. These examples indicate the numerous opportunities for interactive maps to support collaboration.

Keywords
Collaborative activities

INTRODUCTION
Communities are often associated with physical space. For example, a community of local people is usually associated with a town. Likewise, an office space has a certain community of workers. This space is the commonality between the community members and causes many community activities to be spatial. As a result, software for communities often requires a representation of this space. For example, a community web site usually includes a map. The map might be an imagemap with links to various areas of the space or the map might provide community information, such as interesting places. There are numerous uses for a community map on the web.

Web browsers and most web pages are designed only as single-user applications, but communities can also benefit from spatial representations in collaborative applications. Such applications encourage community development as they can bring together people independent of distance and time. For example, a collection of neighbors might carry on an asynchronous discussion, from their own homes, about a map of a nearby empty building lot.

Maps are an ideal way to represent community space. People are familiar with looking at maps. Atlases are commonly found in people's cars, many people have looked at a globe, and even a trip to the mall has people glancing at a map. Also, maps already exist for many spaces. For example, both town maps and building floor plans are common occurrences. Most importantly, maps can exploit the common, community knowledge of the space they represent. By including well-known landmarks and highly visited places on a map, users will more easily identify with the representation and, in turn, find the map easier to work with.

Adding maps to an application's interface is not limited to just a static picture. Interactive maps provide new features over traditional maps and support novel interactions. For example, an interactive map could support zooming, a task that would usually require additional flat maps. In particular, vector-based map data provides many possibilities for interactivity. With this format, software programs can easily manipulate the data and provide different displays in real-time. For example, a user could interact with a map by adding and removing different layers, changing the display scale, and applying different projections.

The use of interactive maps in community applications opens up a range of new activities. Particularly interesting are the new opportunities for collaboration. The rest of this paper highlights some of the ways interactive maps can be used to support collaboration in a community application. First, it discusses the use of map-based navigation in a collaborative environment. A map-based navigation prototype and its evaluation are described, along with some lessons learned and recent extensions. Other community activities that could be enhanced with interactive maps and collaboration include virtual tours, historical collection, and spatial planning. Ideas about each are discussed.

MAP-BASED NAVIGATION
MOOsburg is a collaborative environment based on the town of Blacksburg, Virginia (Figure 1). The goal of this environment is to support community development in Blacksburg by providing community members with a new way to communicate. Ideally, users will build distinct locations within the environment, similar to rooms, and establish a community network [4].

Typically, the room metaphor implies that all the interactions that occur within a room are only viewable by the local users present. This allows for multiple, independent conversations to be going on at the same time, but it limits users' awareness of one another. For example, a user will only learn about the interesting activities in a room if he/she enters that room by chance, limiting the opportunities for collaboration. Yet, distinct locations have many positive attributes. They can encourage the development of social networks and support individual and group activities, as well as synchronous and asynchronous work [2,3]. There is not a definitive design for how users navigate and explore this type of environment, but ideally we would want to limit isolation and support awareness.

Traditional text-based MUDs and MOOs offer one way to implement distinct locations. Yet, this approach is not well suited for collaborative environments. Most of the movement commands pertain to an adjacent room and navigation through the environment occurs through multiple, repeated commands. This step-by-step process is not only tedious, but it also requires the user to recall the spatial layout. An alternative implementation involves map-based navigation. An interactive map provides a visible structure for the environment and enables direct access to locations. In this way, users can focus on the collaborative activities occurring within the rooms, rather than navigating between rooms.

Figure 1. MOOsburg interface, including the map-based navigation prototype (lower right). User "wschafer" is visiting the Drillfield location.

Prototype Design

Our map-based navigation prototype supports two typical scenarios of MOOsburg. It allows users to explore the environment and virtually visit various places in Blacksburg, and it supports specific place-based tasks. For example, someone may log on to visit the Virtual Science Fair happening at the local middle school.

Users navigate by interacting with the map through zooming, dragging, and clicking. The zoom level is controlled continuously by a slider widget. Users can also click and drag the map, causing a panning effect to occur, or click on the map to have the clicked location move to the center.

The use of vector data also enables the prototype to support layers and projections. Major roads and major landmarks are displayed at zoomed out views. By zooming in, all roads are displayed followed by roads and buildings at the most zoomed in views. We also have implemented four different projections that provide a collection of fisheye views (Figure 2). These projections give the user extra contextual information on the periphery of the map when working with zoomed in views. The map-based navigation prototype, including these features, is available as a demo on the web at: http://java.cs.vt.edu/~wschafer/Mapview.html

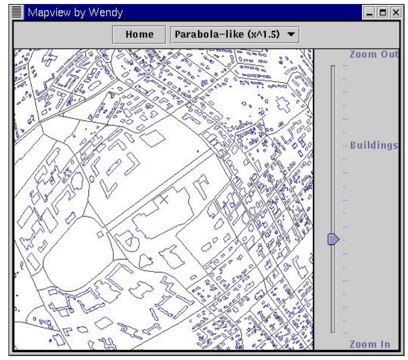

Figure 2. Map-based navigation prototype displaying a fisheye view based on a parabolic function.

Formative Evaluation

Twelve users from three different user groups in the community helped guide our prototype design. Middle school students, college students, and senior citizens completed navigation tasks using both paper mockups and the map prototype. The results suggested some guidelines for map-based navigation.

First, we observed that individual users have different perceptions of the same location. For example, some of the users did not recognize a major intersection in town when we gave them the road names. Yet, they seemed to know this crossroads in a different way, such as the intersection with the video store on the corner.

Users also differed in their familiarity with the environment. For example, those who lived in a particular section of town knew more about the various places and roads in that section than the other users.

Differences also exist between user groups, particularly in respects to landmark knowledge and navigation strategies. For example, places believed to be major landmarks in town were recognized by the middle school students and senior citizens, but not by the college students. In respects to navigation strategies, the college students and senior citizens would utilize road names throughout the session, while the middle school students relied solely on the buildings to navigate. This reveals a need for landmarks in all views, not just in zoomed in displays.

One part of the evaluation asked the users to point out places on paper mockups of the fisheye views. During this task, all of the users indicated a preference for the views with recognizable landmarks, independent of the projections. Along the same lines, we also observed users trying to recognize large, prominent buildings. This emphasizes how important landmarks are to navigation.

The evaluation also demonstrated that users easily learn the shapes of buildings and roads. As the sessions progressed, buildings and roads discovered in previous tasks were referenced in later tasks by all of the users.

Lastly, we observed that users need visual reminders of how to interact with the map. Map-based navigation in a collaborative environment is a two-step process - navigation to a place and then participating in an activity at that place. Many of our users forgot how to work with the map when we varied paper mockup tasks and prototype tasks. This indicates that users will need visual reminders of map interactions after visiting a place in a collaborative environment as well.

Extensions

Following the evaluation, the prototype was additionally enhanced to support MOOsburg's hierarchy of spaces (containers) and places (landmarks). A user either navigates to a landmark, or, if the landmark is itself a space with a substructure, the user can go into the landmark. Buildings are typical spaces and rooms are typical landmarks within these spaces. This allows users to model Blacksburg more accurately and it provides structure to the community network.

Each space corresponds to a different map and as a user chooses to enter a space, the new map is displayed with the previous map shrunk to a small icon (Figure 3). The small maps remind users of their location within MOOsburg as they explore subspaces. They also provide an easy way to exit subspaces, where clicking on a small map returns you to that space. For example, clicking on the small map in Figure 3 would cause the full Blacksburg map to appear in the window and the user would return to the Blacksburg space.

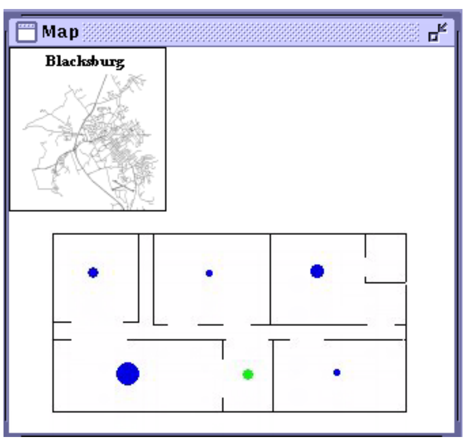

Figure 3. Extensions to the prototype - support for a hierarchy of spaces and places and awareness information about the number of users at a location.

The prototype also has been extended to function as an awareness tool in MOOsburg. The map provides a graphical overview of the environment, which can be designed to provide awareness cues visually. For example, the map can indicate rooms with many objects, rooms with many users, or rooms that are visited most often. This should guide users to find interesting activities and encourage collaboration between users. Our prototype portrays the current user activity by using variable spot sizes, based on the number of users at a location (Figure 3).

OTHER APPLICATIONS

Interactive maps can be used to support a range of collaborative, community activities. For example, in real space communities often offer tours to introduce non-locals to their community. This is mimicked on the web as a virtual tour, where individual users often follow a step-by-step directed path. Yet, this experience could be greatly enhanced as a collaborative activity using a map. A tour would be more engaging if a user followed a dynamic route guided by a community member also using the system. Map-based navigation for a community environment could support this activity by allowing users to link their navigation and/or viewpoint of the map. Linking navigation would provide a way to synchronize travel through the environment, eliminating much discussion about where the tour was headed next and how to get there. Linking viewpoints would allow users to discuss structural layouts of the environment along the tour, as everyone would have an identical view of the map.

Map-based navigation of a community environment could also enhance a single-user tour application. For example, the map could recognize common paths through the environment and suggest these to newcomers. This might prevent a user from getting an exhaustive tour, but it would indicate specific places where other community members visit and suggest the activities they participate in. This use of an interactive map is not necessarily collaborative, but it will encourage collaboration as the user taking the tour may find community members or activities that interest him/her.

Another collaborative, community application enabled by interactive maps involves the collection of historical information. In real space, communities often have records of their history, such as member lists, records of community events, and records of major community changes. This information is not always complete or accurate as often only a few people are in charge of advancing and maintaining this history. An interesting collaborative activity is to encourage community members to remember the past and document it in a community application. This could move the role of historian from a few people to a community-wide effort. If publicly available, it could also give outsiders a feel for how the town once was and how it has progressed.

Interactive maps enable this type of activity, as spatial changes are an integral part of a community's history. In fact, older maps of the community could set the stage for such an activity and prompt users to remember the past. People enjoy reminiscing about "the way things used to be". For example, it is fun to remember previous roadways, buildings, and businesses in a town. An interactive map could be used as the tool to recreate this history. It could allow users to page through history, look at community member's contributions, and add their own recollections.

Another opportunity provided by interactive maps is a collaborative planning application. Communities are typically interested in new spatial plans. For example, townspeople like to evaluate how new roads and new buildings will affect their community and voice their concerns. Likewise, office workers want to be involved in deciding how a new open space will be laid out and partitioned. An interactive map directly supports these discussions. It can display different spatial layouts such as the current arrangement, different proposals, or different combinations superimposed. The map could also allow collaborative annotation so that the communication channel is extended beyond talking. For example, two small groups could have independent discussions involving many annotations before they gather together to compare their thoughts and prepare a single list of concerns.

User interactive maps within community applications, like historical collection and planning, is different than multiple users looking at a geographic information system (GIS). GIS systems are typically used to analyze spatial data sets. These systems focus on details, precision, and static, presentation views. For example, a GIS map could indicate an ideal park area by simultaneously displaying soil types and wildlife patterns for a region. Interactive maps, on the other hand, are designed so that casual users can work independently or collaboratively. Their use occurs at a high-level of detail in comparision GIS maps, and they encourage dynamic, real-time view changes, as well as personalization of the map through annotations.

CONCLUSIONS

A number of different community applications enabled by interactive maps have been presented. All of these have focused on new collaborative activities that are available with interactive maps. These applications indicate the numerous opportunities for interactive maps to support collaboration.

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